ZOÖLOGY.

Excavating Habits of our Common Sea-Urchin.—The habit of certain species of sea-urchins of boring in solid rock is well-known, and has been again and again described, and made a subject of more or less extended study by naturalists. Although familiar with this work of the sea-urchins from descriptions and the study of specimens from other coasts, it has never been my good fortune to observe specimens of rock excavated by our species of Strongylocentrotus (*S. drobachiensis*) before the present summer. As other naturalists may have an interest to know of a place where this process can be readily seen, I have ventured to call their attention to the locality where it was observed.

The eroded rocks of the shore of Grand Manan and the sunken ledges about it offer exceptional features for the study of the phenomenon referred to, but even here it is rare and difficult to observe, although for miles and miles the bottom just below low tide is paved with these echinoderms. There are only limited localities where the excavating of these animals can be seen. One of the best places is on the Black Ledges, a few miles from Nantucket, Grand Manan. These ledges, wholly covered by high tide, are beaten at times by a tremendous sea, and around them course the violent tides of the Bay of Fundy. At low water they are bare ridges of rocks more or less covered with kelp, their surfaces with depressions in which standing water remains between low and high water. The sea-urchins in these pools lie so closely packed together that they touch each other, forming the bristling carpeting of their floors. In one of these pools these echinoderms have made excavations in the rock from one to three inches in depth, perfectly symmetrical and smooth, so close together that the rock has an appearance of the surface of honeycomb when the inhabitants of the cavities are removed. The rock in which these curious formations occur is a hard, gray slate, readily scratched with a knife, forming seams between the harder quartzite so prominent on many of the islands. The excavations are confined to the softer rock, and, as far as observed, were not seen in the quartzite. The sides of the basin in which they were found lie at an angle of about 80°, or almost perpendicular to the floor. The ridges which separate the cavities are tipped by a thick, calcareous, purple alga, which, while it may increase the apparent depth of the cavity as measured from the rim of the same, is comparatively thin as respects the depth of the excavation itself.

Near by this pool there are others with sea-urchins, apparently under the same conditions, where there is no sign of excavations, and long stretches of coast on the neighboring island, where the rock is perfectly paved with sea-urchins, show no attempt on the part of these animals to form even the slightest depression in the rock surface. The existence of these excavations is exceptional even in the Black Ledges, and the phenomenon is thought to be rare even on Grand Manan. Except that possibly the spines about the mouth were stouter than those found on sea-urchins which had not made the excavations, there is nothing to distinguish the inhabitants of the excavations from their neighbors. In no case was it found that the sea-urchins had sunken into the rock below its surface level, nor were the animals in any instance larger than the entrance of the cavities, or unable to escape from the holes in which they were found, as seen in so many specimens in our museums.

It is said by fishermen that our sea-urchins bore into the birch stakes used in building weirs, but I was unable to observe this phenomenon. In some places, however, the back and outer rings of the wood fibre was removed, apparently by them.

The one explanation of this work of the sea-urchins which an examination of the cavities suggests, is that they bury themselves in this way for protection, or for a more effective way of clinging to the cliff, but if such is the true explanation, why is the habit so localized and limited in area?

The method by which the cavities are hollowed out of solid rock is also a prolific subject for a theory, and many explanations have been advanced. I incline to believe that it is simply the effect of a mechanical erosion in the case of the Grand Manan specimens which were studied.

The rate of wearing of the holes is very slow, and there is reason to believe that many sea-urchins were concerned in the production of one excavation. The individual which at present occupies the cavity is probably the last of a series of several members, and the same may be true even when the sea-urchin is larger than the entrance to the chamber in which it lives. When the sea-urchins are removed from the cavities and the excavations uncovered a new tide will repeople them, so that there is little change in their appearance. The new denizens take up the work where their predecessors left off. This continued work, undisturbed for years, by successive sea-urchins, in time forms the cavities. Their own movements, and the wash of the sea,

possibly that of the tides, combine to file away the rock under their soft spines, which are renewed or replaced as time goes on.

It is instructive in connection with a mechanical explanation of the excavating habit of the sea-urchins to consider a geological phenomenon which the cavities inhabited by these animals at once suggest. The pot holes found between tides at certain points on Grand Manan are very beautiful examples of rock cavities worn by stones found within them. The general appearance of the sea-urchin cavities is much the same except in size and depth. The worn surfaces of the cavities are almost identical, and there seems no good reason why we should look for different causes in the two cases. All bowlders, even on apparently good positions, do not form potholes, as the majority of sea-urchins do not wear away a cavity for themselves, but in certain circumstances they do, and the result of the erosion is almost identical. It therefore seems as if it were far-fetched to bring in an acid secretion of the sea-urchin as an agent in forming these depressions in the rocks. It also seems as if the movement of the body did not wholly account for them, but that they are, in part at least, due to the erosion of the rock by the sea beating them against the rock surface, notwithstanding they are practically anchored by their feet.

I hope to be able later to present a more extended account of these sea-urchin excavations, accompanied by illustrations in which it will be possible to show the successive growth of a typical depression. What is here given, while it has a bearing on the deep cavities made in rocks by other species of echinoids, does not necessarily apply to them, but only to the excavations of *S. drobachiensis* found at Grand Manan.—J. WALTER FEWKES.

Moulting of Spiders.—M. Wagner (*Annales des Sciences Naturelles*, VI. 4, 5, 6), contributes an extensive review of the moulting processes which take place in the Arachnida. The writer does not confine himself to the formation of the new integument and the rejection of the old one, but treats also of the formation of the hairs, and the moulting of the eyes, respiratory organs, glands, intestines, and tendons, as well as the modifications observed in the blood-corpuscles during the process, and the biological phenomena which accompany the moulting. The interval between the old and new integument is at first filled with liquid, but this is absorbed before moulting. The new cuticle, unable to expand upon the thorax, forms folds, and the new hairs are held in tubes of the old cuticle. The old skin splits at the line of junction of the upper and lower parts of the cephalothorax, and

the members gradually free themselves from their sheaths, commencing posteriorly. This is the ordinary mode, but there are exceptions. The Tarantula (*Trochosa singoriensis*) passes through four moultings before commencing an independent life, and passes through several others before it attains full size. The author describes the peculiarities of certain genera. The hairs of an arachnid are produced from the lowest stratum of the cuticle, which rises in the form of a tube and perforates the upper layers, and are unicellular. The moulting of the eyes is confined to a comparatively sudden increase, the retina withdrawing itself from its envelopes. Sight is lost during the process, but it does not seem that that process in simultaneous in all the eyes. The moulting of the lungs is accomplished at once, and breathing is difficult during its duration, but the time occupied is short. Two of the three layers which compose the tracheæ are lost during moulting. The linings of the silk glands of the arachnids are shed, the broken parts of the old tubes remaining among the silk by which the arachnid is attached during the moult, and all glands formed by ectodermic invagination also lose their linings. The pharynx, œsophagus, and rectum take part in the moult, as do also the tendons, especially of the muscles of the limbs, the matrix growing around the old tendon and forming a new one, while the old one atrophies and is cast away with the tegument. During the operation of moulting the number of spherical corpuscles, which usually is only three to four per cent. of the total number of corpuscles, increases to ten per cent., almost all the colored corpuscles being transformed into spheres. Want of movement during the process seems to be one, but not the sole, cause of this change in the condition of the blood, and it must be remembered that a development of all the internal parts of the body takes place at the moulting period, so that the casting off of the teguments, etc., is really but a secondary act.

Some Arachnida seem to pass through the entire process of moulting easily, and take little or no precaution (many Thomisidæ, *e.g.*), while others, as many Attidæ and the adult Trochosa, take all possible precautions to shelter themselves from danger, since after the rejection of the tegument they are so feeble that an insignificant foe can master them. If a limb be detached immediately after a moult, it is renewed before the next moult, but if the loss takes place a short time before moulting, only a papilla is formed in the interval. Increased time is occupied in the moulting of adult individuals, and spiders do not moult in winter nor when deprived of nourishment for a considerable time.

Zoölogical News.—Cœlenterata.—Some points in the life history of the coral Fungia are given by Mr. J. J. Lister in the *Quarterly Journal of Microscopical Science.* When young, examples of *Fungia discus* and *F. dentata* are attached by a broad base and have vertical thecal walls. The youngest have six septa larger than the rest. After a varying height has been obtained, the upper part begins to widen out, forming at first a shallow cup with thecal walls facing outwards and downwards, and finally a disc depressed in the center, with the thecal walls facing directly downwards, the cup still remaining attached to the narrow stalk. After awhile absorption of the calcareous skeleton takes place at the junction of disc and stalk until the former falls off. At first there is a round scar on the centre of the free disc corresponding with a similar scar on the top of the stalk, the scar showing the thecal wall and sections of the septa, which latter unite with the trabeculæ that fill in the middle. The scar in time becomes covered, and finally all trace of it is lost.

The soft tissues are first exposed in the scar. The septa unite with the trabeculæ, which fill in the middle. In the disc there is no communication with the gastric region, except through the interspaces among the trabeculæ. The surfaces of the calcareous structures where absorption has taken place are white and opaque as compared with the general surface of the hard parts of the coral.

The first change visible in the stalk is that the septa throw up delicate fluted laminæ with serrated edges. A mouth is formed in the center, and the lips, in spirit specimens, seem almost in contact with the trabeculæ below. A thecal wall then springs up, usually a little within the margin of the thecal wall of the stalk. A new cup is thus formed, as the product of the structures in the base of its predecessor. As the walls grow they expand outwards, until a new disc is formed, and the former round of changes repeated. The stalk grows in height with each detachment, the place of every one of which is marked by a ridge.

Dr. von Lendenfeld thinks Fewkes' parasitic hydroid *Hydrichthys mirus* a Sarsia (*Biol. Centralblatt,* IX., p. 53). It is described in this journal (Vol. XX., p. 354).

Ortmann has been studying the stony corals of the Strasburg Museum, and gives some generalizations on their distribution. (*Zool. Jahrbuch,* Bd. III.) He says there are two faunæ,—an Indo-Pacific and an Eastern-American,—and these have only two species (*Heliastraca annularis* and *Siderastraca radius*) and nine genera in common,

and these nine genera are old Tertiary forms. He, therefore, thinks that the two faunæ have been distinct since the Tertiary. In the Atlantic he recognizes two divisions,—a West Indian and a Brazilian.

Worms.—The development of *Peripatus novæ-zealandicus* receives elucidation from Miss Lilian Sheldon in the *Quarterly Journal of Microscopical Science* for December. The eggs were removed from the uterus immediately after the mother had been killed with chloroform. Out of forty-five examples, twenty-two were males and nine females without ova: the others had from seven to eighteen eggs. The ovum is heavily charged with food-yolk. The development is antrolecithal, and the protoplasm is mainly at one pole. From the stages of development observed on embryos extracted in December, April, January, and July, Miss Sheldon concludes that the ova pass from ovary to uterus in December, and that the young are born in July.

Mr. F. E. Beddard (*Quart. Jour. Micr. Sci.*, Dec. 1888) has an article on certain points in the strutures of Urochæta, with especial reference to the excretory system of it and other earth-worms. The paper also includes a description of *Dichogaster damonis*, n. gen. et sp. The writer concludes with a review of the various modifications of the nephridial system found on earthworms, commencing with Perichæta, in which the nephridial network is continuous from segment to segment, and thus distinctly comparable with that of the Platyhelminths, and ending with Lumbricus, in which there is but a single pair of nephrida per segment. In Dichogaster (as in Acanthodrilus) the network of nephridial tubules is discontinuous at the septa, and the tubules are longer, less abundant, and occupy less space than in Perichæta. In Dichogaster the nephridia of the posterior segments are larger, and open by a single cœlomic funnel. In Dinodrilus some specimens show a slight connection from segment to segment.

Crustacea.—M. R. Koehler has studied the so-called scales of the peduncle of Pollicipes, and states that they are not comparable with those of the peduncle of Scalpellum, but have a peculiar and complicated structure, and are not properly scales. Their form is that of rectangles with rounded angles, and they are ranged in longitudinal and oblique lines upon the chitinous layer of the peduncle.

MM. A. Grird and J. Bonnoir have discovered a cryptoniscian isopod parasitic upon the amphipod *Angelisca diadema*. It is the first epicaridan that has been discovered upon an amphipod, and in its characters approaches *Cryptothiria marsupialis*. It has been named *Podascon dellevallei*. Not less curious is the discovery by the same

naturalists of *Aspidœcia nouveani*, a parasite upon a parasite, residing in the posterior part of the dorsal buckler of *Aspidophryxus sarsi*.

Insects.—From the researches of M. J. K. d'Herculais, it appears that the locust most to be dreaded in Algeria, and, in fact, in North Africa generally, is not *Acridium peregrinum*, the locust of the Bible, but *Stauronotus maroccanus*, an autochthonous species of different habits. *A. peregrinum* has its permanent home in Central Africa, probably in the region of the great lakes. Its subpermanent region is that part of Africa between the Sahara and its home, while the entire north of Africa is its temporary region, where it cannot maintain itself more than two years. This locust arrives in Algeria in April or May in immense flocks, couples soon afterwards, and the females deposit deeply in the earth, in damp spots, egg cases containing eighty or ninety eggs. Two months later the young appear, and continue the ravages commenced by the parents. In forty-five days they acquire wings, and take flight. *S. maroccanus* has a wide geographical distribution, embracing all the mountains and districts around the Mediterranean from Spain to the Caucasus. It is a lover of dry and mountainous districts. The winged adults appear in Algeria in July and August, and the females deposit at a slight depth, upon rocky and dry ground, notably upon hillsides with a southern or eastern aspect, egg cases containing thirty to thirty-five eggs. The young escape nine months afterwards,—*i.e.*, in the spring of the next year,—and become adult in sixty days. This species loves rugged and mountainous spots, and flourishes where the winters are cold and the summers hot; whereas *A. peregrinum* is a creature of the humid plains and valleys, and needs the heat of summer for its multiplication.

Fishes.—The salmon taken in the rivers of Finland are in many cases found to contain, in the throat or in the alimentary canal, a copper hook of a form unknown in Finland. Among three thousand fishes taken between the end of June and August, 1883, in a salmon-fishing establishment on the river Uba, twenty-five contained a hook of this kind, sometimes with a portion of the attached line. It is now known that these copper hooks are those used in the north of Germany, where the salmon fishery is chiefly carried on in the winter. Thus some of the salmon of the Finnish rivers descend in winter to the Baltic coasts of Germany. A sea fishery of salmon is also carried on upon the coasts of Sweden, and in the island of Bornholm. In the Baltic, as upon the Scotch shores, it is observed that the salmon usually seeks its food upon a sandy bottom. This marine fishery, which

in Bornholm alone produces some twenty thousand salmon, is carried on throughout the year, but is most successful in winter. M. Fendersen has shown that almost every river of Iceland has its peculiar form of salmon, and that each of these forms frequents, during its growth, the seas adjacent to its native river.

EMBRYOLOGY.

Notes on the Development of Ampullaria depressa, Say. —During last spring Mr. Jos. Willcox sent a lot of the large ova of the above-named species of this interesting genus from Florida to my colleague, Professor Leidy, who very kindly placed some of the material at my disposal for study. These ova were placed in the conservatory connected with the Biological School, where they underwent development in an apparently normal way, at the surface of the water in aquaria in which Algæ are kept. It was found that the egg must not be immersed in the water; if immersed they are apparently asphyxiated. This corresponds with what Mr. Willcox has related to me in regard to the habits of oviposition of this fresh-water mollusk; the parent animal creeping, according to his observation, to the surface upon the stems of water plants, and after having reached the portions of the plants which rise above the water, the large eggs are deposited in a single layer on the leaves exposed to the air. Whether a glutinous covering invests the freshly laid ova I was not informed; it is certain, however, that the ova are firmly secured by a transparent glutinous substance to the large leaves of the water plants upon which they are found. Each of the spherical ova adheres to this glutinous matter, and its inferior side rests in a concave depression on the adhesive matter which forms a pretty thick layer on the leaves over the area covered by a brood of eggs. The broods vary in number, and, if the lots which I had under examination were undisturbed before reaching my hands, they may reach the number of forty or more, lying in a group about an inch wide and three or four inches long. Semper found seventy to eighty eggs in a single brood of *A. polita*.

The color of the living ova is pinkish by transmitted, but lighter by reflected light, because of the white of the calcareous shell. The pinkish color is not due to the presence of any coloring matter in the sub-